THE PAST AND PRESENT GEOGRAPHICAL DISTRIBUTION OF PETALOSTEMON FOLIOSUS AND NOTES ON ITS ECOLOGY

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Petalostemon foliosus Gray, a member of the Leguminosae, is a rare plant species that now appears to be restricted to a few localities in central Tennessee and northern Alabama. However, at one time it also occurred in at least four counties (LaSalle, Kankakee, Kane and Will) in northeastern Illinois. Herbarium specimens from these Illinois counties have been cited by Gambile (1953) and (or) Wemple (1965), and specimens are still present in various herbaria (F, GH, ISC, US, NY and ILL). Among the collections in these herbaria the latest one is dated 12 September 1912 (*L. M. Umbach* 5715, in the Iowa State University Herbarium, collected from river flats, Romeo, Will County, Illinois). This may possibly represent the last collection of *P. foliosus* in Illinois. Jones (1963) and Wemple (1965, 1970) state that the species probably is now extinct in Illinois.

Although the species has persisted until the present in several localities in central Tennessee and in at least two locations in northern Alabama, it has not been collected widely and, therefore, very little is known about its distribution in central Tennessee and northern Alabama. In a recent revision of the genus, Wemple (1965) cites specimens from Davidson, Franklin and Rutherford Counties in middle Tennessee and from Knox County in east Tennessee. All of the specimens that he examined from middle Tennessee were collected since about 1915, from a cedar glade area across from Stones River Park, 2 miles northwest of Murfreesboro, Rutherford County, Tennessee. Sharp *et al.* (1960) list the species as occurring in Davidson and Rutherford Counties in central Tennessee and Mahler (1970) lists it from the same two counties and

from Knox County in east Tennessee. Baskin and Caudle (1967) first reported the species from Alabama, in Franklin and Morgan Counties.

While making botanical observations in central Tennessee, we have found the species in several counties where it previously has not been reported. These counties include: Wilson County, Cedars of Lebanon State Forest, 6 August 1971 (*Baskin & Baskin* 1177); Maury County, 2.7 miles east of Columbia on Co. Rd. 50, 23 August 1966 (*Baskin & Caudle* 522); Marshall County, 1 mile east of U. S. 431 on St. Rd. 99, 18 August 1970 (*Baskin & Baskin* 869). In addition, there is a specimen from Williamson County, Tennessee in the Vanderbilt University herbarium (VDB) from along Sneed Road west of Hillsboro Avenue toward the Harpeth River (*Kral* 29001). Actually, this population was discovered earlier by Dr. Elsie Quarterman of Vanderbilt University, but apparently she did not place a specimen in the herbarium at Vanderbilt.

During August 1971, we visited the previously known locations of *P. foliosus* in Franklin and Morgan Counties Alabama, and Marshall, Maury, Williamson and Wilson Counties Tennessee to see if the species was still present in these locations. In all the locations visited we found at least a few plants of the species. From our recent observations on living populations of the species and from available specimens and literature, we have constructed a map of the known past and present geographical distribution of the species (Fig. 1). Although we do not know of specific locations for *P. foliosus* in Rutherford County, Tennessee, at least two collections were made there in the 1960's. One, *L. E. Franklin & J. D. Freeman* 2481, on 26 July 1962 (VDB), and the other, *D. Isley & D. Wemple* 9420, on 11 September 1964 (ISC). Although there have not been any recent collections of *P. foliosus* in Davidson and Franklin Counties, Tennessee, there is no reason to believe that the species is not present there because seemingly suitable cedar glade habitats are available, and the species does occur in nearby counties.

Fig.1. Past and present geographical distribution of *Petalostemon foliosus*.

The occurrence of *P. foliosus* on the "U. T. Farm" in Knox County, Tennessee is represented on the distribution map; it probably was transplanted to that site and no longer survives there. The only specimen that seems to have been collected from this location is 20 September 1938, Lahner (TENN). Sharp *et al.* (1960) do not cite this location.

Gleason (1952) and Gleason and Cronquist (1963) also give the species as occurring in Ohio, but its occurrence there is doubtful. None of the other literature that we examined refers to any specimens collected in Ohio, and Weishaupt (1968) does not include the species in her *Vascular Plants of Ohio.*

The habitat and distribution of *P. foliosus* have been described in various taxonomic and floristic works as follows: river banks, Interior Low Plateau, Tennessee to Illinois (Small, 1933); rocky hills, glades and river banks, northern Illinois to Tennessee (Fernald, 1950); river banks, Illinois, Ohio and Tennessee (Gleason, 1952; Gleason and Cronquist, 1963); river banks and gravelly soil, rare or probably now extinct in Illinois (Jones, 1963) and cedar glades, barrens, Tennessee, northern Illinois and Alabama (Mahler, 1970).

In central Tennessee and northern Alabama *P. foliosus* always is associated closely with cedar glades. On the typical Lebanon limestone glades (for description see Quarterman, 1950), *P. foliosus* usually occurs at the edges of open glades in the transition zone between open glades and glade thickets or woods, a habitat that is shaded during at least part of the day. In this situation *P. foliosus* often is associated with *Astragalus tennesseensis* Gray, *Asclepias verticillata* L. and *Sporobolus vaginiflorus* (Torr.) Wood. In one glade in Marshall County, Tennessee that is more prairie-like than typical Lebanon limestone glades, *P. foliosus* occurs in an opening that receives full daylight throughout the growing season, as well as near a shrub thicket composed of *Symphoricarpos orbiculatus* Moench, *Rhus aromatica* Ait. and *Forestiera ligustrina* (Michx.)

Poir. The open, prairie-like portions of this glade, where *P. foliosus* grows, are dominated by *Panicum capillare* L. Here a layer of mineral soil (30-45 cm deep) overlies solid bedrock. Other plants on this glade with prairie affinities include *Cacalia tuberosa* Nutt., *Helenium autumnale* L. and *Desmanthus illinoensis* (Michx.) MacM. *Petalostemon foliosus* grows in a somewhat similar open, prairie-like situation in Morgan County, Alabama and Williamson County, Tennessee. In Morgan County, Alabama its most frequent associates are *Cassia fasciculata* Michx., *Rudbeckia triloba* L. and *R. hirta* L., and in the glade in Williamson County, Tennessee *Astragalus tennesseensis* and *Delphinium virescens* Nutt. are frequent associates.

Since apparently very little is known about the ecological life cycle of *P. foliosus*, we believe that it is not inappropriate to report here our observations on the phenology of this species in the field. In March new buds located at or slightly below the soil surface at the base of the previous year's growth (shoot) begin growth. By early June the new shoot is 15-20 cm tall. Growth of the shoot in height continues until July by which time plants are typically 40-65 cm tall. An individual plant usually bears one shoot with many inflorescences, but some plants may have several shoots with many inflorescences each. Flower buds apparently are formed in late June or early July and by mid-July large flower buds are visible. Flowering begins in late July or early August and continues through August. The peak of flowering is approximately mid-August. The only insect that we have observed visiting the flowers of this species is a bumblebee (*Bombus* sp.). By early October seeds are ripe and by mid-October the shoots are dead. However, after the shoots die they remain erect and hold the fruiting heads into the winter. Seeds are not shed immediately upon ripening but are dispersed from the plants from late fall to early spring. Our observations indicate that seed set is good.

Germination in the field occurs in April and by late May the seedlings have several leaves. Numerous seedlings of

P. foliosus were present in the Morgan County, Alabama population on 6 April 1972. These seedlings were in the cotyledon or first leaf stage. As in many members of the Leguminosae (Crocker and Barton, 1953), seed coats of most of the freshly-matured seeds of *P. foliosus* are impermeable to water, but will germinate to nearly 100% when mechanically scarified. However, in nature the seed coat must be softened by natural agents before the seeds can germinate. All the seeds produced in a particular seed crop do not soften by the following spring, and it takes several years for the coats of all seeds in a particular crop to soften. We planted 400 seeds on greenhouse potting soil in flats on 11 October 1969 and placed them on a bench in a non-heated room of a greenhouse at the University of Kentucky. Eleven of the seeds germinated during the fall of 1969, indicating that only a very small percentage of the freshly-matured seeds had permeable or soft coats. After overwintering in the greenhouse, 21 additional seeds germinated in the spring of 1970, and to date after three overwinterings) only 89 of the seeds have germinated. During the spring of 1970 most of the germination in the non-heated room of the greenhouse occurred between 8 April and 6 May when the average daily maximum and minimum temperatures in the greenhouse were 23.7 and 11.3°C, respectively. During the spring of 1971 most of the germination occurred bewteen 1 April and 20 April when the average daily maximum and minimum temperatures in the greenhouse were 23.6 and 8.3°C, respectively.

It appears that very few of the seedlings survive to maturity as relatively very few juvenile plants can be found in the field in the summer and fall. Our observations indicate that seedlings are drought intolerant and that many of them are killed by summer drought. We observed dead seedlings during a short dry period in late May of 1971 and others that were badly wilted. Since the species does not reproduce vegetatively and since very few seedlings survive, perennation is a most important factor in maintaining populations of this species. Further evidence that

suggests that seedling survival is poor is that the number of plants in the small populations of this species does not seem to be increasing. For example, in the populations of *P. foliosus* in Franklin County, Alabama and in Maury County, Tennessee where the populations consist of less than 25 plants each, there was no noticeable change in number of plants between 1966 when we first discovered the populations and 1971 when we last observed them.

Petalostemon foliosus is a rare and "endangered" species. Although one of the populations (Morgan County, Alabama) consists of hundreds of individual plants and another one (Williamson County, Tennessee) has several dozen plants in it, all the other populations that we have seen have less than 25 plants. As we have mentioned in a previous article on *Astragalus tennesseensis* (Baskin, Baskin and Quarterman, 1972), another rare cedar glade endemic, the glade habitats in middle Tennessee rapidly are being destroyed or disturbed. Some of the glade habitats that have been destroyed once supported populations of *P. foliosus*. For example, until 1967 there was a sizeable population of *P. foliosus* on a glade 2 miles northwest of Murfreesboro in Rutherford County, Tenn. In 1967 this area was bulldozed in preparation for construction of a box factory and, of course, the entire population was destroyed.

Both the Morgan and Franklin County populations of *P. foliosus* are in a precarious position as is true for the one population of *Astragalus tennesseensis* that we know of in Alabama. The large population, in Morgan County, is located mostly along side a narrow, gravel road and if the road is widened to any extent most, if not all, of this population will be destroyed. The population of *P. foliosus* in Franklin County, Alabama is located on the right-of-way of County Road 79 and should this two lane road be widened this small population (17 plants in 1971) will undoubtedly be destroyed.

The past and present geographical distribution of *P. foliosus* and *A. tennesseensis* are very similar. Both species

once had two centers of distribution; one in middle Tennessee and northern Alabama and another in northern Illinois. Both apparently have become extinct in Illinois and now are restricted to middle Tennessee and northern Alabama. Undoubtedly habitat destruction in the present geographical range of these two species will continue with obvious consequences. It seems reasonable to predict, then, that the two species will become extremely rare and maybe even extinct in this century.

Travel funds for this project were provided by a grant from the University of Kentucky Research Committee. This support is gratefully acknowledged.

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BOOK REVIEW

FLORA OF THE GALÁPAGOS ISLANDS[1]

This splendid volume was published in 1971. The first copies to reach the Galápagos Islands were brought there in June of that year by Dr. William A. Weber. In the interesting review that later appeared under his name in Science (1972) he explained that he was able to test the book on location with the first study tour conducted there for university credit.

Quite by chance the present reviewer was privileged to make a similar test of the book in June and July of that same year. With my wife, I arrived at Baltra Island in the Galápagos on June 22, 1971 to take the two weeks' cruise on the "Golden Cachalot" under Lindblad auspices. The first day out the owner, Mr. David Balfour, learning that I was a botanist, placed an unused copy of the book now under review in my hands whereupon the excursion became not only a most pleasant experience in natural history but an education in Galápagos botany. The copy of the

[1]WIGGINS, IRA L. and DUNCAN M. PORTER. 1971. Stanford University Press, Stanford, California. XVII, 998 pp. + plates. $37.50.